Remarks:

Reconsideration of the application is requested. Claims 1-6 and 8-13 are now in the application. Claims 1 and 9 have been amended. Claims 7 and 14 have been canceled.

In item 2 of the Office action, the Examiner rejected claims 1, 5, and 7 as being fully anticipated by Havemann et al. (U.S. 6,358,849) under 35 U.S.C. § 102(e). The rejection has been noted and the claims have been amended in an effort to define more clearly the invention of the instant application. Support for the changes to claims 1 and 9 is found on page 12, lines 17-end. In amended independent claim 9, the same process parameters added to amended independent claim 1 have been added to the claim language in order to further specify the nature of the specific CF_4 ARC open process used within the present invention.

Before discussing the prior art in detail, a brief review of the invention as claimed is provided. Amended claim 1 calls for, *inter alia*, an etching method that includes the following steps:

> providing a semiconductor structure with functional elements formed in a substrate, a dielectric disposed on the substrate, a photoresist etching mask above the dielectric, and a polymer intermediate layer between the etching mask and the dielectric layer;

etching the dielectric layer and the polymer intermediate layer for the dual damascene patterning with a CF_4 ARC open process with high selectivity with respect to the photoresist of the etching mask, said CF_4 ARC open process including:

adjusting RF power between 550 and 650 watts,
adjusting pressure between 80 and 120 mtorr,
adjusting CF_4 flow between 35 and 45 sccm,
adjusting CHF_3 flow between 17 and 23 sccm,
adjusting Ar flow between 80 and 120 sccm, and
adjusting O_2 flow between 5 and 7 sccm.

In making the rejection, the silicon oxynitride ACR layer 173 described by Havemann et al. (US 6,358,849) has been analogized to a polymer intermediate layer as understood within the present application and that independent claim 1.

In addition, in item 4 of the Office action, the Examiner rejected claim 9 as being unpatentable over Havemann et al. in view of Khajehnouri et al. (US 6,117,786). The basis of the rejection was the assertion that Khajehnouri et al. teach that processing parameters for etching must be determined by test runs and that, therefore, it would have been obvious for the person skilled in the art to determine the process parameters required for the specific process described in independent claims 1 and 9 of the present application.

However, the present invention solves problems connected to the use of polymeric ARC layers in combination with photoresist layers in double damascene processes. The use of

a polymer ARC layer in such processes leads to the problem of the deposition of ARC polymer material in contact holes that have already been opened (*see* specification, page 5, lines 12 to 22). This deposition leads to the formation of so-called "fences" around the contact holes, which in turn makes the subsequent metallization step more difficult or leads to internal stresses in the semiconductor element, proceeding from said fences (*see* Specification, page 5, lines 24, through page 6, line 5).

The invention as claimed solves these problems connected to the use of polymer intermediate layers (ARC-layers) by using a highly selective CF_4-ARC open process using the specific process parameters. Amended claims 1 and 8 further clarify the method for etching both the polymer intermediate layer and the dielectric layer positioned underneath the ARC-layer. This has the effect that any polymer present in the interconnect is etched at the same time as the oxides so that no fence formation can take place (*see* specification, page 9, lines 8 to 17).

The Examiner has argued that the silicon oxynitride layer 173 described by Havemann et al. represents an intermediate polymer layer as understood within the present application and has based his understanding on the disclosure given on page 5, lines 1 to 10, which states the following:

> A photolithography method is used for this as standard, wherein method an intermediate layer made of a polymer, i.e. an ARC polymer as antireflection layer, is inserted below the photoresist layer in order to preclude reflections during the exposure of the photoresist and hence to minimize the reflected light and thereby to improve the resolution. This involves as standard photo-process for sub-0.5 mm technologies with DUV (deep ultraviolet) exposure. Antireflection layers of this type may **comprise** (emphasis added) organic or inorganic materials.

Contrary to the opinion of the Examiner, this paragraph, which discusses a **prior art process**, should not be interpreted as meaning that within the present invention the ARC layer should be made of a polymer material. Irrespective of this fact, the final sentence of this paragraph, which states that the ARC layer may comprise organic or inorganic materially, only makes clear that additional organic or inorganic materials may be present in the antireflection layer in order to modify its properties. This sentence is not to be understood in the sense that the ARC layer itself may be made fully of and inorganic materials such as silicon oxynitride described by Havemann et al. Consequently, the Examiner errs when arguing that this sentence is to be understood in the sense that any inorganic material may be used for the ARC layer and that, therefore, such inorganic ceramic materials such as silicon oxynitride also have to be considered to represent polymeric materials as understood by the present application.

Ceramic inorganic materials such as silicon oxynitride, due to their ceramic, inorganic nature, are not deposited as polymeric layers and a polymer deposition during etching based on this material does not occur. Therefore, the problem addressed by the present invention does not occur when using such ceramic inorganic materials as the ACR layer.

Therefore, one with ordinary skill in the art would know that the silicon oxynitride layers described by Havemann et al. were not polymeric layers in the sense of the present application. Consequently, amended independent claim 1 is not anticipated by the Havemann et al. Furthermore, amended independent claim 1 now comprises specific process parameters used within the present invention. These process parameters are also not disclosed by Havemann et al.

Amended independent claim 1 and amended independent claim 8 are also not made obvious by the Havemann et al. in view of Khajehnouri et al. First of all, the fact that it is known in the art that process parameters for specific new etching processes have to be determined by test runs does not make the teaching of these two independent claims obvious. Every invention in the field of etching technology requires test runs to determine the required process parameters once the underlying concept, i.e. invention, has been thought of.

In the present case, both claims are directed at a specific etching process in which both CF_4 and CHF_3 are used as etchants and in which an antireflection layer made of a polymeric material used in combination with a photoresist layer is etched simultaneously with the underlying dielectric layer. The combination of the use of the polymeric ARC layer together with the specific process parameters solves the problem of unwanted polymer deposition in the vias during etching of the dielectric layer and thus avoids "fence" formation. Contrary to this, Havemann et al. describe a process in which a ceramic inorganic antireflection layer is used. Khajehnouri et al. describe a method for etching silicon dioxide using fluorocarbon gas chemistry. But this reference teaches that only **hydrogen-free** C_nF_m compounds, in which **n is at least 2** and m is greater than n should be used in order to avoid etch stop due to polymer deposition (*see* column 2, lines 14 to 18, and column 3, line 66 to column 4, line 6). Therefore, **both CF_4 and CHF_3 are considered unsuitable** by Khajehnouri et al. for the etching process described by them. Consequently, the person skilled in the art would not consider the teachings of this reference when faced with the problem of devising a specific etching process that uses both of these fluorocarbon compounds as etchants.

Because Havemann et al. do not disclose the use of polymeric antireflection layers and because Khajehnouri et al. explicitly teach away from using CF_4 and CHF_3 as etchants when structuring narrow vias or holes into silicon dioxide layers, it cannot be assumed that one with ordinary skill in the art would consider these two documents in combination. Moreover, even if one were to assume that one would, this combination would still not disclose all the features comprised in amended independent claims 1 and 9. Additionally, because neither of the two documents cited by the Examiner addresses the problem of avoiding "fence" formation, one with ordinary skill in the art would be given no incentive to combine these two documents.

Accordingly, none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1 or 9. Therefore, claims 1 and 9 are patentable over the art. Moreover, because all of the dependent claims are ultimately dependent on claim 1 or 9, they are believed to be patentable as well.

In view of the foregoing, reconsideration and allowance of claims 1-6 and 8-13 are solicited. In the event the Examiner should still find any of the claims to be unpatentable, please telephone counsel so that patentable language can be substituted. In the alternative, the entry of the amendment

is requested as it is believed to place the application in better condition for appeal, without requiring extension of the field of search.

If an extension of time for this paper is required, petition for extension is herewith made.

Please charge any other fees that might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner and Greenberg, P.A., No. 12-1099.

Respectfully submitted,

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